UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	684.2745
First Named Inventor or Application Identifier	NAOTO SANO, ET AL.
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form
(Submit an original, and a duplicate for fee processing)

2. [X] Specification — *Total Pages* 23

3. [X] Drawings *(35 USC 113)* — *Total Sheets* 03

4. [X] Oath or Declaration — *Total Pages* 02

   a. [ ] Newly executed (original or copy)

   b. [X] Unexecuted for information purposes

   c. [ ] Copy from a prior application (37 CFR 1.63(d))
   (for continuation/divisional with Box 17 completed)
   [Note Box 5 below]

   i. [ ] DELETION OF INVENTOR(S)
   Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).

5. [ ] Incorporation By Reference *(useable if Box 4c is checked)*
The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.

6. [ ] Microfiche Computer Program *(Appendix)*

7. Nucleotide and/or Amino Acid Sequence Submission
(if applicable, all necessary)

   a. [ ] Computer Readable Copy

   b. [ ] Paper Copy (identical to computer copy)

   c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [ ] Assignment Papers (cover sheet & document(s))

9. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney

10. [ ] English Translation Document *(if applicable)*

11. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations

12. [ ] Preliminary Amendment

13. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)

14. [ ] Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired

15. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)

16. [ ] Other: _____

17. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information:*

[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. ___/_____

18. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label — 05514 (Insert Customer No. or Attach bar code label here) — or [ ] Correspondence address below

NAME					
Address					
City		State		Zip Code	
Country		Telephone		Fax	

+

CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	32-20 =	12	X $ 22.00 =	$ 264.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	2-3 =	0	X $ 82.00 =	$ 0
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			$270.00 =	$ 270.00
				BASIC FEE (37 CFR 1.16(a))	$ 790.00
				Total of above Calculations =	$1324.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				
				TOTAL =	$1324.00

19. Small entity status

a. ☐ A Small entity statement is enclosed

b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.

c. ☐ Is no longer claimed.

20. ☒ A check in the amount of $1,324.00 to cover the filing fee is enclosed.

21. ☐ A check in the amount of $ _____ to cover the recordal fee is enclosed.

22. The Commissioner is hereby authorized to credit overpayments or charge the following fees to Deposit Account No. 06-1205:

a. ☒ Fees required under 37 CFR 1.16.

b. ☐ Fees required under 37 CFR 1.17.

c. ☐ Fees required under 37 CFR 1.18.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED	
NAME	STEVEN E. WARNER Registration No. 33,326
SIGNATURE	Steven E. Warner
DATE	September 30, 1998

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GAS LASER DEVICE AND EXPOSURE APPARATUS USING THE SAME

FIELD OF THE INVENTION AND RELATED ART

This invention relates to a gas laser device such as a noble gas halide excimer laser device or a F_2 laser device, for example. In another aspect, the invention is concerned with an exposure apparatus or a semiconductor device manufacturing method wherein such a gas laser device is used as an exposure light source.

In the field of semiconductor device production or other fields, a noble gas halide excimer laser (hereinafter, simply "excimer laser") which is one of gas lasers has attracted much attention as a high power laser. As for such excimer laser, there are XeCl excimer laser (308 nm wavelength), KrF excimer laser (248 nm wavelength), and ArF excimer laser (193 nm wavelength), for example. Similarly, F_2 laser (158 nm wavelength) has attracted much attention as a high power laser. Also, semiconductor device manufacturing exposure apparatuses of step-and-repeat type or step-and-scan type having KrF excimer laser (248 nm wavelength) as an exposure light source have already been used in practice.

In excimer lasers, a laser gas containing a noble gas and a halogen gas is sealingly stored in a

chamber, and the laser gas is once excited by electric discharging from an electrode, provided in the chamber, whereby laser light is produced. Also, in F_2 lasers, a F_2 gas is sealingly stored in a chamber, and the laser gas is once excited by electric discharging from an electrode, provided in the chamber, whereby laser light is produced.

SUMMARY OF THE INVENTION

In such excimer lasers or F_2 lasers, it is necessary to circulate the laser gas within the chamber in order to feed the laser gas to the electric discharging field of the electrode. To this end, within the chamber, there is circulating means for laser gas circulation such as a blowing machine (blower or circulating fan), for example. If the lifetime of the blowing machine provided in the chamber is short, the operation of the laser has to be stopped frequently for replacement of the laser or blowing machine or for repair of the same. In cases where the laser is used as a light source in an exposure apparatus, it largely affects the productivity of the apparatus. Since the blowing machine is disposed within the chamber, it takes a much time for replacement or repair of the same.

A factor that influences the lifetime of the blowing machine may be the lifetime of bearing means

for holding a rotational shaft of blowing fans of the blowing machine. Generally, the lifetime of bearing means is shorter with a larger load applied in operation. Therefore, if the number of revolutions of the blowing fans is enlarged to increase the blowing power of the blowing machine with a result of enlargement of the load applied to the bearing means for supporting the rotational shaft, it accelerates wear and shortens the lifetime of the bearing. Namely, if the blades of the blowing machine are rotated at a high speed for high frequency laser oscillation, the lifetime of the bearing means for supporting the blade rotational shaft of the blowing machine is shortened.

However, in an exposure apparatus having an excimer laser, for example, as an exposure light source, normally it is required that the excimer laser is oscillated at a high frequency for improved processing performance of the apparatus. Therefore, it is not practical to use the blowing machine at its low blowing power level for prolongation of the lifetime of the bearing. On the other hand, for the reasons described above, if replacement or repair of the excimer laser or the blowing machine occurs frequently, in an exposure apparatus having an excimer laser as an exposure light source, it leads to decreased productivity or throughput.

Further, in gas laser devices, the lifetime of the blowing machine disposed in the chamber where the laser gas is stored should be longer than the lifetime of at least the chamber.

It is accordingly an object of the present invention to provide a gas laser device having a long lifetime and a high power.

It is another object of the present invention to provide an exposure apparatus or a device manufacturing method with use of such a gas laser device as an exposure light source, whereby high productivity is assured.

In accordance with an aspect of the present invention, there is provided a gas laser device, comprising: a chamber for sealingly storing a laser gas therein; a discharging electrode for exciting the laser gas through electric discharging, so that laser light is outputted from said chamber; circulating means for circulating the laser gas within said chamber so that the laser gas passing an electric discharging region of said discharging electrode is circulated in said chamber and is returned to said electric discharging region of said discharging electrode; and control means for controlling said circulating means so that said circulating means provides different gas circulation capacities, being different for an in-operation state in which the laser

gas is excited by electric discharging from said discharging electrode and the laser light is outputted and for a stand-by state which differs from said in-operation state but in which laser light can be outputted.

Said control means may be operable to stop the gas circulation through said circulating means when said gas laser device is in said stand-by state. Said circulating means may include a blowing machine provided within said chamber. Said blowing machine may have a blowing blade rotatably supported within said chamber. Said laser device may comprise one of a noble gas halide excimer laser and a F_2 laser. Said noble gas halide excimer laser may comprise one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

In accordance with another aspect of the present invention, there is provided an exposure apparatus for exposing a substrate with the laser light, comprising: a laser light source having a chamber for sealingly storing a laser gas therein, a discharging electrode for exciting the laser gas through electric discharging, so that laser light is outputted from said chamber, and circulating means for circulating the laser gas within said chamber so that the laser gas passing an electric discharging region of said discharging electrode is circulated in said

chamber and is returned to said electric discharging region of said discharging electrode; a major assembly for exposing a substrate with laser light from said laser light source; and control means for controlling said circulating means so that said circulating means provides different gas circulation capacities, being different for an in-operation state in which the laser gas is excited by electric discharging from said discharging electrode and the laser light is outputted and for a stand-by state which differs from said in-operation state but in which laser light can be outputted.

Said control means may be operable to stop the gas circulation through said circulating means when said gas laser device is in said stand-by state. Said circulating means may include a blowing machine provided within said chamber. Said blowing machine may have a blowing blade rotatably supported within said chamber. Said laser device may comprise one of a noble gas halide excimer laser and a F_2 laser. Said noble gas halide excimer laser may comprise one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

In accordance with a further aspect of the present invention, there is provided an exposure apparatus, comprising: a laser light source having (i) a chamber for sealingly storing a laser gas therein,

(ii) a discharging electrode for exciting the laser gas through electric discharging so that laser light is outputted from said chamber, and (iii) circulating means for circulating the laser gas within said chamber so that the laser gas passing an electric discharging region of said discharging electrode is circulated in said chamber and is returned to said electric discharging region of said discharging electrode; a main assembly for exposing a substrate with the laser light from said laser light source; and control means for controlling said circulating means so that said circulating means provides different gas circulation capacities, being different for an exposure-operation state of said exposure apparatus in which exposure of the substrate with the laser light from said laser light source can be performed through said main assembly, and for a non-exposure-operation state of said exposure apparatus.

Said control means may be operable to increase the gas circulation capacity of said circulating means in response to start of an exposure job in which the exposure operation is performed through said main assembly. Said control means may be operable to hold gas circulation through said circulating means stopped before start of the exposure job. Said circulating means may include a blowing machine provided within said chamber. Said blowing

machine may have a blowing blade rotatably supported within said chamber. Said laser light source may comprise one of a noble gas halide excimer laser and a F_2 laser. Said noble gas halide excimer laser may comprise one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

In accordance with a further aspect of the present invention, there is provided a semiconductor device manufacturing method in which a pattern is lithographically transferred onto a substrate by use of any one of the exposure apparatuses as described above.

These and other objects, features and advantages of the present invention will become more apparent upon a consideration of the following description of the preferred embodiments of the present invention taken in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a schematic view of an exposure apparatus with a gas laser device, according to an embodiment of the present invention.

Figure 2 is a longitudinal section of a chamber of the gas laser device.

Figure 3 is a lateral section of the chamber of the gas laser device.

Figure 4 is a schematic view for explaining details of a rotational shaft of a blower.

Figure 5 is a flow chart for explaining operation with the gas laser device of this embodiment.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows an exposure apparatus according to an embodiment of the present invention. Denoted in Figure 1 at 1 is a main assembly of a step-and-repeat or step-and-scan exposure apparatus, called a stepper. Denoted at 2 is a console with which an operator, for example, can apply a job command to a control system (not shown) in the exposure apparatus main assembly 1, for controlling the operation of the main assembly. Denoted at 3 is a laser light source having a gas laser device which is based on a noble gas halide excimer laser (called "excimer laser"), or a F_2 laser, for example. Examples of such excimer laser may be XeCl excimer laser (308 nm wavelength), KrF excimer laser (248 nm wavelength), and ArF excimer laser (193 nm wavelength). The following description will be made on an example wherein the laser light source 3 uses a noble gas halide excimer laser.

The main assembly 1 of the exposure apparatus comprises a beam shaping optical system 4 for rectifying, into a desired beam shape, the sectional

shape of laser light from the laser light source 3, along the path of laser light (laser beam). The main assembly further comprises a variable ND filter 5 for adjusting the intensity of laser light, and an optical integrator 6 for dividing the laser light and superposing the divided beams one upon another for uniform illuminance upon the surface of a reticle 12. The main assembly further comprises a condenser lens 7 for collecting laser light from the optical integrator 6, and a beam splitter 8 for directing a portion of the laser light from the condenser lens 7 toward a photodetector 15. The main assembly further comprises a masking blade 9 disposed at a position where the laser light is collected by the condenser lens 7 and for regulating the range on the reticle 12 surface to be irradiated with the laser light. The main assembly further comprises an imaging lens 10 for forming an image of the masking blade 9 upon the reticle 12, and a mirror 11 for directing the path of laser light toward the optical axis direction of a projection lens 13.

The reticle 12 can be illuminated with laser light projected by the laser light source 3 and passed through the illumination optical system having optical components such as described above. With this illumination, a pattern of the reticle is projected by the projection lens (projection optical system) 13

onto one of different exposure shot areas on a semiconductor wafer (substrate) in a reduced scale of 1/2 to 1/10, whereby the pattern is lithographically transferred thereto. The wafer 14 can be moved two-dimensionally along a plane perpendicular to the optical axis of the projection lens 13, by means of a movable stage (not shown). As the exposure of a certain shot area on the wafer is completed, the wafer is moved to the position where the pattern of the reticle 12 is to be projected by the projection lens 13 onto a next shot area on the wafer.

Denoted at 16 is signal processing means for processing a photoelectrically converted signal, having been photoelectrically converted by the photodetector 15 and corresponding to the intensity of the laser light. Through integration of photoelectrically converted signals, a signal for controlling the exposure amount can be produced. A control signal obtained with the signal processing through the signal processing means 16 is fed back to a controller 31 of the laser light source 3. In accordance with this control signal, the controller 31 controls the subsequent light emission by the laser gas in the chamber 30 of the excimer laser 3.

Figure 2 is a longitudinal section of the chamber 30 of the excimer laser 3. Denoted in Figure 2 at 32 is a pair of discharging electrodes which are

connected to a high voltage source (HV), not shown. On the basis of the electric discharging from the discharging electrodes 32, the laser gas LG portion which is placed in the discharging region 33 between the discharging electrodes 32 is excited, whereby laser oscillation is executed in a known manner. The electric discharging from the discharging electrodes 32 is repeated periodically, such that as shown in Figure 3 the excimer laser 3 provides periodic outputs or oscillation of laser light 40.

The laser gas LG within the chamber 30 of the excimer laser 3 is circulated in the chamber 30 in directions (counterclockwise in Figure 2) denoted by arrows in the drawing, by means of a blower or circulating fan 34 of a blowing machine (circulating means) which is provided within the chamber 30. Thus, the laser gas LG passing the electric discharging region 33 of the discharging electrodes 32 is circulated in the chamber 30 and is moved back to the discharging region 33 of the electrodes 32. During this circulation process, the laser gas LG passes around a heat exchanger 35 so that it is cooled to a desired temperature. Within the heat exchanger 35, there is a flow of temperature regulating fluid such as a temperature controlled water or air, which is supplied from a temperature adjusted fluid supplying device (not shown) disposed outside the chamber 30.

As shown in Figure 3, there are windows 36 and 37 before and after the electric discharging region 33 in the chamber 30 of the excimer laser 3. The laser light produced at the discharging region 33 is amplified while being passed through the windows 36 and 37 and being reflected by an output window (half mirror) 38 (which is a laser output end) and a total reflection mirror 39. A portion of the thus amplified laser light is outputted from the output window (half mirror) 38, whereby laser light 40 is emitted as exposure light. During this process, the blower 34 is continuously rotated to circulate the laser gas LG within the chamber 30 as described above. When the laser oscillation frequency has to be increased, the number of revolutions of a blower drum 340 (Figure 4) of the blower 34 is increased to enhance the blowing power of the blower accordingly.

Around the blower drum 340, there are a number of blades (blowing fans) 345 as shown in Figure 2 mounted. With the rotation of the blower drum 240, these blades 345 operate to circulate the laser gas LG within the chamber 30. The blower drum 340 has a rotational shaft 341 which is rotatably supported by bearing means (rotational shaft supporting means) such as ball bearing 342, for example. The lifetime of the ball bearing 342 changes with the load applied to the ball bearing 342, and the load changes with the

rotation speed or rotation time of the blower drum 340.

The operation of this embodiment will now be described with reference to the flow chart of Figure 5. As a voltage source for the excimer laser 3 (laser light source) is powered on at step S0, the sequence goes to warming-up state at step S2 while the laser is kept in laser-off state at step S1. In the warming-up state at step S2, the electric discharging from the discharging electrodes 32 is not initiated, and also the blower 34 is kept stopped. The remaining functions are operated such that, in this state, in response to start of electric discharging from the discharging electrodes 32, the laser emission can be executed promptly.

In this state, if at step S3 an exposure job start signal, for example, is applied from the console 2 of Figure 1 to the stepper main assembly 1 and the excimer laser 3, the electric discharging from the discharging electrodes 32 of the excimer laser 3 is initiated. Simultaneously, the blower 34 starts its rotation to initiate circulation of the laser gas LG in the chamber 30. Thus, the excimer laser is brought into a laser-on state at step S4, such that laser light 40 is produced from the output window 38 of Figure 3. On the other hand, within the stepper main assembly 1, a wafer 14 introduced into the main

assembly 1 is taken out of a wafer cassette, and it is placed on a wafer stage (not shown) which is placed at an exposure position below the projection lens 13. Additionally, after execution of a predetermined alignment operation with respect to a reticle 12, the exposure process is performed at step S5 by using the laser light 40 as exposure light. The exposure operation in the stepper main assembly 1 is repeatedly and sequentially performed until exposures of all wafers 14 set beforehand are completed.

Until the exposure operation at step S5 is completed, the blower 34 in the chamber 30 continues its rotation to continue its blowing operation. During this period, at step S4 the laser controller 31 continuously detects the rotation speed (number of revolutions) of the blower 34. If there is any error in the number of blower revolutions, the electric discharging from the discharging electrodes 32 is discontinued. Also, the blower 34 rotation is stopped. By this, the laser goes back to the warming-up state at step S2. In that occasion, the laser controller 31 signals the error in the laser 3 to the console 2, such that the console 2 applies a signal to the stepper main assembly 1 to stop the job being executed, whereby the exposure operation in the stepper main assembly 1 is stopped.

If, on the other hand, any error in the

number of revolutions is not detected, the exposure operation at step S5 is continued, and the exposure job is performed until exposures of all the wafers 14 set in the stepper main assembly 1 are completed. When, at step S6, exposures of all the wafers 14 in the stepper main assembly 1 are completed and the exposure job thereto is accomplished, the stepper main assembly 1 signals the exposure job completion to the console 2. In response, the console 2 signals the exposure job completion in the main assembly 1 to the controller 31 of the laser 3. In response, the laser controller 31 stops the blower 34 rotation and, additionally, it stops the electric discharging from the discharging electrodes 32 whereby laser oscillation from the excimer laser 3 is stopped.

In this embodiment, the blower 34 rotates only in a period in which exposure operation is performed in the stepper main assembly 1 or in a period in which the excimer laser 3 provides laser light oscillation. On the other hand, in the stepper main assembly 1, there is a job, other than the exposure job, which necessitates oscillation of the excimer laser 3 for measurement of illuminance non-uniformness upon a reticle 12 or a wafer 14, or for temperature stabilization of the projection lens 13, for example. During a period in which such a job is executed, the blower 34 is rotated. In accordance

with this embodiment of the present invention, the period of term for replacement or repair of the blower 34 or bearing means 342, that is, the lifetime of it, can be prolonged. Particularly, the lifetime of the blower 34 may be made longer than that of the chamber 30.

While the invention has been described with reference to the structures disclosed herein, it is not confined to the details set forth and this application is intended to cover such modifications or changes as may come within the purposes of the improvements or the scope of the following claims.

WHAT IS CLAIMED IS:

1. A gas laser device, comprising:

a chamber for sealingly storing a laser gas therein;

a discharging electrode for exciting the laser gas through electric discharging, so that laser light is outputted from said chamber;

circulating means for circulating the laser gas within said chamber so that the laser gas passing an electric discharging region of said discharging electrode is circulated in said chamber and is returned to said electric discharging region of said discharging electrode; and

control means for controlling said circulating means so that said circulating means provides different gas circulation capacities, being different for an in-operation state in which the laser gas is excited by electric discharging from said discharging electrode and the laser light is outputted and for a stand-by state which differs from said in-operation state but in which laser light can be outputted.

2. A gas laser device according to Claim 1, wherein said control means is operable to stop the gas circulation through said circulating means when said gas laser device is in said stand-by state.

3. A gas laser device according to Claim 2, wherein said circulating means includes a blowing machine provided within said chamber.

4. A gas laser device according to Claim 3, wherein said blowing machine has a blowing blade rotatably supported within said chamber.

5. A gas laser device according to Claim 1, wherein said laser device comprises one of a noble gas halide excimer laser and a F_2 laser.

6. A gas laser device according to Claim 5, wherein said noble gas halide excimer laser comprises one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

7. A gas laser device according to Claim 1, further comprising an exposure apparatus for exposing a substrate with the laser light.

8. A gas laser device according to Claim 7, wherein said control means is operable to stop the gas circulation through said circulating means when said gas laser device is in said stand-by state.

9. A gas laser device according to Claim 8, wherein said circulating means includes a blowing machine provided within said chamber.

10. A gas laser device according to Claim 8, wherein said blowing machine has a blowing blade rotatably supported within said chamber.

11. A gas laser device according to Claim 8, wherein said laser device comprises one of a noble gas halide excimer laser and a F_2 laser.

12. A gas laser device according to Claim 11, wherein said noble gas halide excimer laser comprises one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

13. An exposure apparatus, comprising:

a laser light source having (i) a chamber for sealingly storing a laser gas therein, (ii) a discharging electrode for exciting the laser gas through electric discharging so that laser light is outputted from said chamber, and (iii) circulating means for circulating the laser gas within said chamber so that the laser gas passing an electric discharging region of said discharging electrode is circulated in said chamber and is returned to said

electric discharging region of said discharging electrode;

a main assembly for exposing a substrate with the laser light from said laser light source; and

control means for controlling said circulating means so that said circulating means provides different gas circulation capacities, being different for an exposure-operation state of said exposure apparatus in which exposure of the substrate with the laser light from said laser light source can be performed through said main assembly, and for a non-exposure-operation state of said exposure apparatus.

14. An apparatus according to Claim 13, wherein said control means is operable to increase the gas circulation capacity of said circulating means in response to start of an exposure job in which the exposure operation is performed through said main assembly.

15. An apparatus according to Claim 14, wherein said control means is operable to hold gas circulation through said circulating means stopped before start of the exposure job.

16. An apparatus according to Claim 15, wherein

wherein said circulating means includes a blowing machine provided within said chamber.

17. An apparatus according to Claim 16, wherein said blowing machine has a blowing blade rotatably supported within said chamber.

18. An apparatus according to Claim 13, wherein said laser light source comprises one of a noble gas halide excimer laser and a F_2 laser.

19. An apparatus according to Claim 18, wherein said noble gas halide excimer laser comprises one of XeCl excimer laser, KrF excimer laser, and ArF excimer laser.

20. A semiconductor device manufacturing method in which a pattern is lithographically transferred onto a substrate by use of an exposure apparatus as recited in any one of Claims 7 - 19.

ABSTRACT OF THE DISCLOSURE

A high power and long lifetime gas laser device suitably usable in an exposure apparatus is disclosed. The gas laser device includes a chamber for sealingly storing a laser gas therein, a discharging electrode for exciting the laser gas through electric discharging, so that laser light is outputted from the chamber, and a circulating system for circulating the laser gas within the chamber so that the laser gas passing an electric discharging region of the discharging electrode is circulated in the chamber and is returned to the electric discharging region of the discharging electrode, and a control system for controlling the circulating system so that the circulating system provides different gas circulation capacities, being different for an in-operation state in which the laser gas is excited by electric discharging from the discharging electrode and the laser light is outputted and for a stand-by state which differs from the in-operation state but in which laser light can be outputted.

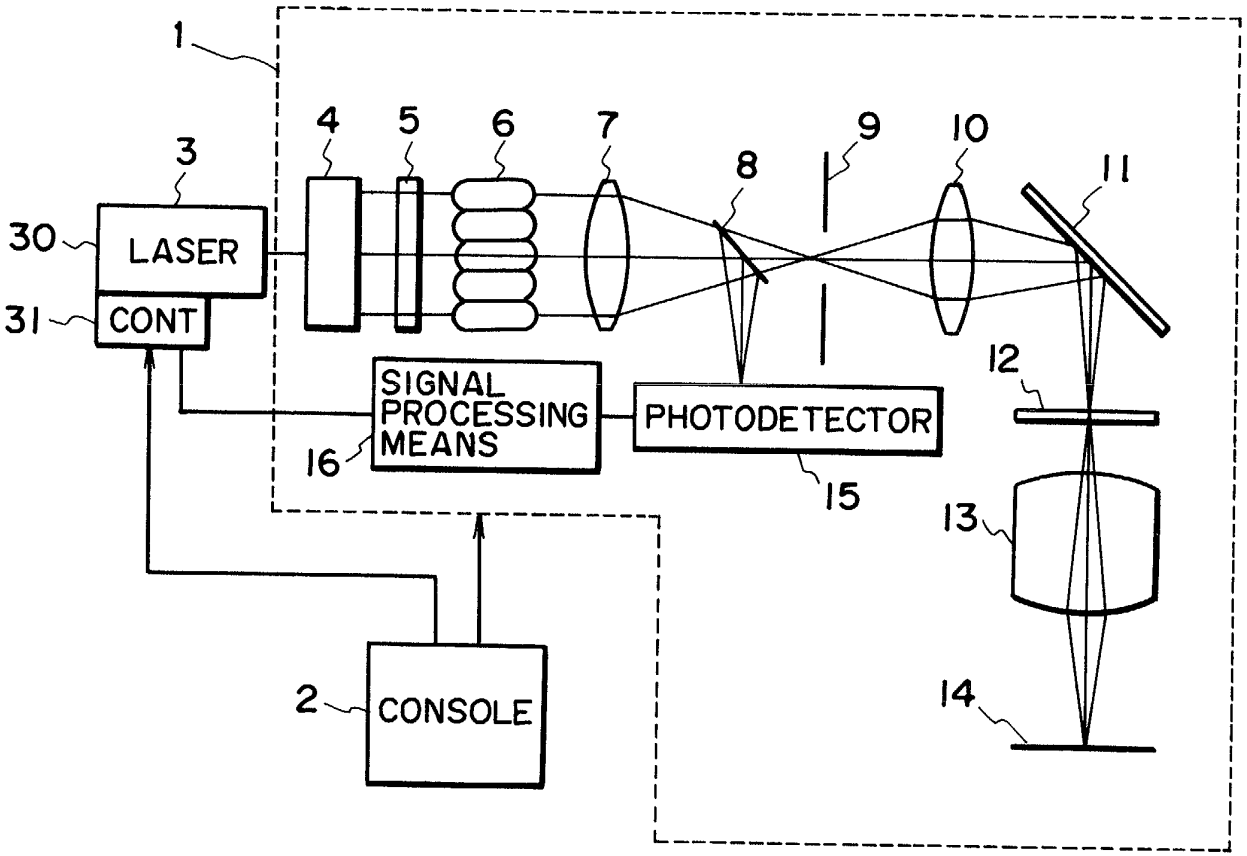

FIG. 1

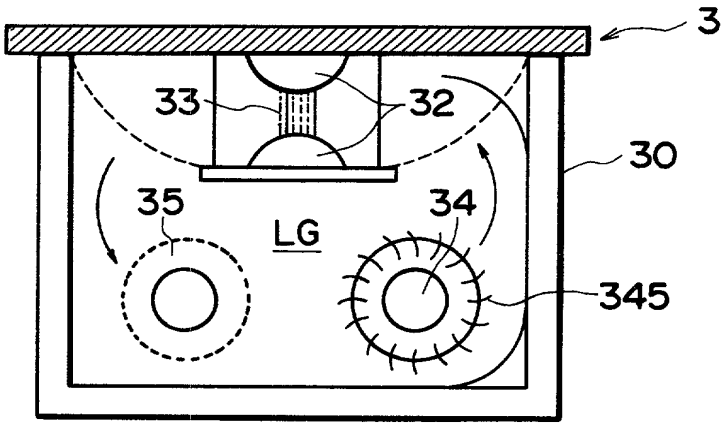

FIG. 2

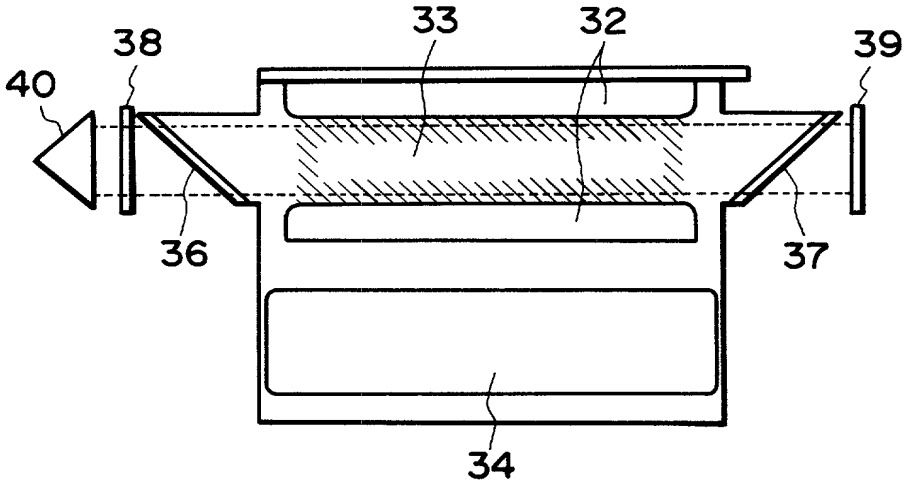

FIG. 3

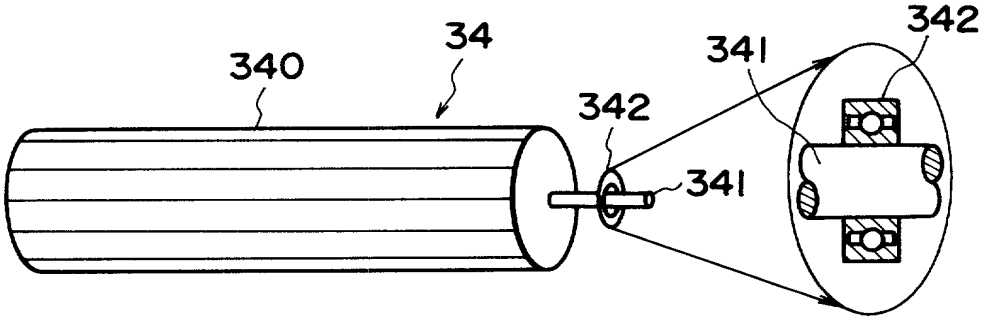

FIG. 4

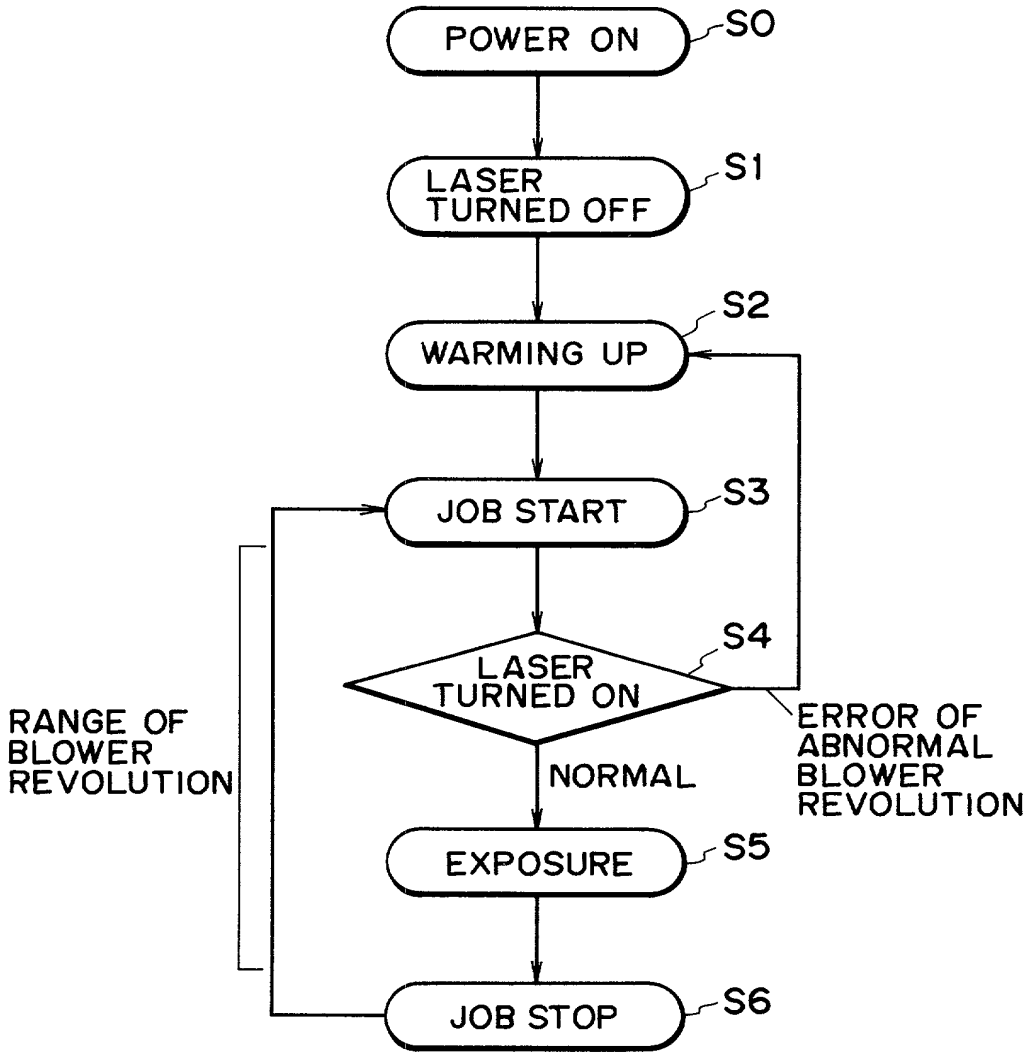
POWER ON
S0
LASER TURNED OFF
S1
WARMING UP
S2
JOB START
S3
LASER TURNED ON
S4
RANGE OF BLOWER REVOLUTION
ERROR OF ABNORMAL BLOWER REVOLUTION
NORMAL
EXPOSURE
S5
JOB STOP
S6

FIG. 5

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
(Page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am an original, first and joint inventor of the subject matter which is claimed and for which a patent is sought on the invention entitled GAS LASER DEVICE AND EXPOSURE APPARATUS USING THE SAME, the specification of which [X] is attached hereto [ ] was filed on _____ as United States Application No. or PCT International Application No. _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed.

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed
Japan	9-271253	3/October/1997	Yes

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

Application No.	Filed (Day/Mo./Yr.)	Status (Patented, Pending, Abandoned)

I hereby appoint the practitioners associated with the firm and Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

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(Page 2)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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